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ABSTRACT

Fifty-three students from six to thirteen years old participated in a study designed to compare the achievement of auditorally and visually deficient learning disabled students under three different treatment methods. Once students were found to meet the study's criteria for learning disabilities, they were further assessed, and 34 students were assigned to an auditory deficit category, nine were assigned to a visual deficit category, and ten were found to have no identified process dysfunction. Subjects within each category were randomly assigned to one of three treatment procedures: auditory process training and reading, visual process training and reading, and reading only. Prescriptions were written for subjects in the auditory and visual training groups, and students in these groups were taught in subgroups of no more than six for a total of 40 hours over a 20-week period, while the "reading only" group engaged in enrichment activities. Because of the low number of subjects identified as having a visual process skill deficit, the original design of the statistical analysis was not carried out; instead, data analysis was conducted on 22 of the subjects with auditory skill deficits. The major finding was that, of these subjects, those who had the auditory training failed to show improvement in auditory skills when compared to those in the other two treatment groups. Process training therefore remains essentially nonvalidated for increasing process skills. (GT)

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FINAL REPORT

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Reading as a Function of Visual
and Auditory Process Training

Submitted to:

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Introduction

The educational utility of visual and auditory process training has been a center of controversy since the development of the Developmental Test of Visual Perception (DTVP) by Marianne Frostig (1961) and the Illinois Test of Psycholinguistic Abilities (ITPA) by Kirk, McCarthy and Kirk (1968). Advocates of process training (Kirk and Kirk, 1971; Frostig, 1968; Bush and Giles, 1969; Minskoff, 1975; Lund, 1978) have attempted to show that training the process skills (derived from the factors which the test measures) can have a positive effect on the academic achievement of students with academic deficits. On the other hand, numerous studies have pointed out a lack of construct validity (Hammill, 1972; Wiederholt, 1971) and a lack of improved achievement as a result of prescriptive application of these test results (Hammill and Larsen, 1974; Wilson, Harris and Harris, 1976; Vellutino, 1977). The evidence in favor of the critics of process training continues to mount, and the open debate (Exceptional Children, September, 1974; November, 1975; February, 1978; March, 1978) continues to linger. Indeed, with the appearance of publications advocating direct behavioral approaches to academics (Vellutino, 1977) and advocating task analysis of academic skills (Siegel, 1974; Resnick, 1973), the zeitgeist does not favor the advocates of process training. The position of process training advocates appears to be more and more empirically untenable, while the stance of its process critics remains firm. The onus is upon process training advocates to demonstrate "experimental validation to verify their theories and approaches" (Hammill and Larsen, 1978).

The notion that children with specific learning disabilities possess process deficits which are manifested by their lack of academic achievement is an integral part of the National Advisory Committee on Handicapped Children's (1968) definition of specific learning disabilities. This definition has since

been adopted by the United States Office of Education:

> Children with specific learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in spoken or written language. These may be manifested in disorders of listening, thinking, reading, writing, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do not include learning problems which are due primarily to visual, hearing, or motor handicaps, to mental retardation, emotional disturbances or to environmental disadvantage (USOE, 1968, p. 16).

This definition is decidedly more oriented toward the goal of education of these children than are definitions such as "minimal brain dysfunction"; however, the medical, psychoneurological definition of why problems exist remains in a prominent position in the definition. In fact, the first sentence of the definition, "Children with specific learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language," indicates that the etiology of poor academic performance is as yet unknown and is worthy of further investigation. It is no wonder that educators continue to attack a primarily educational problem by exploring a psychoneurological theory for the underlying causes of deficits in academic achievement.

If process training is to have beneficial effects, then the results of testing should be applied in a prescriptive manner. In addition, process techniques applied prescriptively should demonstrate the best results when used in conjunction with a diagnostic, prescriptive, task-analytic approach to academic instruction. This has been the attempt of the present study: to identify L.D. students with an auditory or visual process dysfunction and then to apply the test data in a systematic fashion in conjunction with diagnostic, prescriptive, task-analytic academic instruction. In addition, the investigators opted to avoid using measures of psycholinguistic abilities based on the Osgood-Kirk model, e.g., the ITPA, and selected other essentially non-validated

assessment instruments in order to shed more light on the effective use of other assessment instruments and treatment programs.

Method

Subjects

The criteria set for a learning disability within this study follow the definition of the United States Office of Education (USOE). Functionally, this definition requires that (1) the subjects have an IQ within normal limits as measured by an individual intelligence scale; (2) subjects must be at least one year behind in reading achievement as measured by both individual and group measures of reading ability; and (3) subjects must have visual and auditory acuity within, or corrected to within, normal limits.

The subjects for the present study were identified by the Jefferson County (Alabama) or Birmingham City School Systems as being LD or as in need of evaluation for a possible learning disability. Eighty students were referred to the Center for Developmental and Learning Disorders (CDLD) for evaluation; fifty-three of these students actually met criteria for LD and participated in the initial phase of the study. Age range for subjects was 6.7 to 13.6 years; IQs ranged from (Full Scale) 84 to 113, with an average Full Scale IQ of 92. Several subjects wore glasses but none wore a hearing aid.

Procedure

Each student had an extensive educational evaluation prior to acceptance into the Learning Lab at the CDLD. This evaluation included an individual oral reading test, a phonic skills test, and an individual criterion-referenced math skills test. From test information each student's individual educational plan (IEP) was written. The IEP was developed following the diagnostic-prescriptive model.

Once it had been determined that a student met criteria for the study, the

subject was then assessed in terms of auditory and visual processes. Three instruments were administered to each subject. Three subtests of the Goldman-Fristoe-Woodcock Auditory Skills Test Battery (G-F-W) were administered. These tests included Auditory Discrimination, Auditory Selective Attention and Auditory Memory. The Memory subtest is further divided into three sections: Recognition Memory, Content Memory, and Memory for Sequence. Each of these five measures has a percentile score associated with it. Criterion for auditory dysfunction was set at a percentile rank of 20% or below on any two of the five measures. For assessment of the visual process two tests were selected: The Developmental Test of Visual-Motor Integration (VMI) (Berry, 1967) and the Motor-Free Test of Visual Perception (MVPT) (Collarusso and Hammill, 1972). These two instruments were used in combination in order to avoid placing too much emphasis on visual-motor skills (VMI or MVPT). The VMI was selected to measure the visual-motor skills of all subjects. On the other hand, the MVPT was used to indicate overall visual perception and to indicate which aspects of visual perception might be deficient. The areas tapped by the MVPT include spatial relations, visual discrimination, figure-ground, visual closure, and visual memory. Criterion for the visual deficit category was set at a Perceptual Age (PA) one year or more below the subject's chronological age.

In addition, a third category was anticipated. This category is one reflecting no identified process dysfunction; it included subjects who met neither criterion for a process deficit but did meet criteria for learning disability.

Once the testing was completed and the subjects were assigned to one of three deficit categories, subjects were then placed in one of three treatment groups. These treatment groups included Auditory Process Training and Reading,

Visual Process Training and Reading, and Reading Only. Subjects within each deficit group were randomly assigned to one of these three treatment procedures. Table 1 depicts both the number of subjects within each deficit group and the number of subjects within each of the three treatments.

Insert Table 1 about here

After assignment of subjects' treatment groups, teachers and student teachers wrote prescriptions for treatment of subjects within the Auditory Training and Visual Training groups. Subjects within the Auditory Training cell had prescriptions designed to remediate the auditory dysfunction. Subjects within the auditory dysfunction group had prescriptions written to capitalize upon strengths in the visual process. The visual dysfunction/ Visual Training group had a prescription for remediation, while the visual dysfunction/Auditory Training group had a prescription to teach to auditory strengths. Subjects with no process deficits participated in activities in order to remove the effects of not receiving any of the added activities. Subjects in the Reading Only group participated in supplemental activities in order to avoid the effects of either extra time spent in reading or of lack of attention during the other subjects' process training time.

Prescriptions included information taken from the assessment instruments relevant to the process training instruction of the subjects. For example, students within the auditory deficit/Auditory Training group who showed deficits in Auditory Memory on the G-F-W were given exercises from Developmental Learning Materials' Auditory Memory Program of the Auditory Perceptual Training Program (APT), or activities recommended by Bush and Giles (1969) concerning auditory association or auditory sequential memory. Appropriate activities for such remediation were also selected from the Minskoff, Weisman and Minskoff kit.

In another example, subjects with an auditory deficit assigned to the Visual Training group had prescriptions which were written to capitalize upon their strengths as defined by the MVPT or VMI. A subject with strengths in visual memory, spatial relations and figure-ground subtest areas was given activities from the MWM kit for visual reception or from Bush and Giles for visual reception, or Visual Sequential Memory exercises from DLM or suggested activities from Frostig-Horne or from See It-Do It. A subject within the visual dysfunction/Visual Training cell who had deficits in form constancy and spatial relations would have a prescription written to include activities to improve abilities within these areas as suggested by Frostig-Horne, Bush and Giles, and Developmental Learning Materials (DLM), and these were supplemented by appropriate language activities from the Minskoff, Weisman and Minskoff (MWM) kit. Subjects assigned to the visual dysfunction/Auditory Training group followed a similar instructional scheme to the auditory dysfunction/Visual Training group. Visual strengths as identified by the MVPT or VMI were listed, and teachers directed their attention to the increased strengthening of these processes. An example of this type of training would be with a subject who has difficulty in auditory memory (as identified by the G-F-W) and strengths in visual memory. This subject's prescription would be written to include such activities as (1) DLM See It-Do It (visual memory) exercises; (2) from Bush and Giles: copying patterns, tracing shapes, or putting cartoons in order; and (3) supplementing with activities from other DLM kits.

The personnel involved in the administration of tests and the writing of activities within each treatment procedure included Learning Lab staff, master's degree student teachers and master's degree graduate students in special education at the University of Alabama in Birmingham. Learning Lab staff served as preceptors for the testing, prescription-writing and instruction

done by the graduate students and student teachers. The Learning Lab is housed in three classrooms at the Center for Developmental and Learning Disorders. During any instruction period no more than six subjects were present in each class. One LD specialist with a master's degree in Learning Disabilities was assigned to each class. Two to three student teachers were also present in each class over the 20-week period of the study. Either the LD specialist or the student teacher led the process training activities. These instructors were also supplemented by graduate students completing pre-practicum classroom experiences. The effects of teacher difference cannot be discounted in regard to the three master teachers, although these three individuals seemed to be equally competent. However, since other instructors, student teachers and graduate students also participated in both the reading instruction and process training, the effects of teacher variables should not be considerable. In addition, the randomizing of subjects into treatment procedures was random over classes to which they were assigned for instruction, i.e., students within each of the three treatment groups could be found in each classroom.

At the end of the 40 hours of treatment all subjects were administered the five subtests of the G-F-W and three subtests of the Metropolitan Achievement Test (MAT). These post-test scores were then used in statistical analysis.

Results

In reviewing the results of the process diagnostic testing, the prevalence of auditory and visual process skill deficits in this sample can be determined. The data in Table 1 reveal that 60% (34 out of 53) of the subjects were identified as having an auditory process skill deficit and nine out of 53, or 20%, were identified as having a visual process deficit. Ten out of the 53, or 20%, were found to meet neither criterion for auditory or visual process deficits. The low number of subjects identified as having a visual process

skill deficit made the original design of the statistical analysis impossible to carry out with any degree of confidence in the results. Therefore, the statistical analysis of the data was carried out on 22 subjects identified as having an auditory skill deficit. Table 2 provides the number of subjects, average chronological age and average Full Scale IQ for each of the three treatment groups.

Insert Table 2 about here

The statistical analysis for G-F-W was performed using raw scores from each of the tests, since the battery is the same for all ages. However, the use of standard scores for the MAT was necessary since three levels of this test were administered to accommodate the wide range of academic abilities of the sample. Statistical analyses across various levels of the MAT are appropriate using standard scores (Prescott, 1973). Table 3 presents pre and post raw scores for the G-F-W and pre and post standard scores for the MAT.

Insert Table 3 about here

An analysis of variance was performed on the post-test scores both of the G-F-W and MAT following the general linear model of the 1976 Statistical Analysis System (Barr, Goodnight, Sall and Helwig, 1976). Covariance was used in order to control for the effects of initial individual achievement and intelligence differences (Dayton, 1970). Covariance for initial achievement and intelligence differences was necessary in order to equalize these differences for all subjects. This allows the use of post-test scores only and eliminates the need for difference scores with the inherent increase in the standard error of their mean associated with the use of difference scores.

The ANOVA revealed no statistical differences attributable to treatment

for the five G-F-W subtests. Table 4 depicts the ANOVA table for this analysis.

Insert Table 4 about here

ANOVA for the three MAT subtests revealed a significant difference due to treatment for word knowledge (F=8.51, p .005) and for the total reading score (F=5.96, p .016). No treatment differences were found for arithmetic. In addition, R-square was calculated as an indication of the proportion of total variation in the experiment that is associated with the experimental treatments (Cronbach, 1957). R-squares indicate that about 80% of the total variation for MAT scores is attributable to the three treatment procedures. Table 5 depicts the ANOVA results for the MAT post standard scores.

Insert Table 5 about here

Duncan's Multiple Range Test (Barr et al., 1976) was performed on both G-F-W and MAT scores to determine which, if any, of the treatments were statistically superior. Since cell frequencies were unequal, Kramer's adjustment was used by SAS-76 (Kramer, 1956). Table 6 presents the results of the Duncan's Multiple Range Test for the five G-F-W subtests. Inspection of these results reveals no significant differences between treatments for these five variables.

Insert Table 6 about here

A Multiple Range Test for the MAT variables indicates a statistically significant difference at the .05 level between the Visual Process training and Reading treatment and both of the other treatments for word knowledge. A statistically significant difference at the .05 level was found between the Visual Process training and Reading treatment and the Auditory Process training

and Reading treatment for the MAT reading variables. No differences in MAT reading were found in the comparison of Visual and Reading treatment and Reading Only treatment nor in the comparison of Auditory and Reading and Reading Only treatment. No treatment differences were found for the MAT arithmetic variable.

Insert Table 7 about here

Discussion

The original intent of this study was to compare the achievement of auditorally and visually deficient LD students under three different treatment methods. At the outset it was realized that this would be very difficult to accomplish with any degree of confidence in the results, given the low number of subjects identified as having a visual process deficit. However, the fact that so high a percentage of learning-disabled students were identified as having auditory skill deficits and so few were identified as having visual skill deficits is worthy of further investigation. To date the literature indicates that the rates of incidence of visual or auditory process skill deficits have not yet been determined for the learning-disabled population. The fact that 20% of the LD students in this sample did not meet either criterion also indicates the need for such a demographic study. The possibility exists that the criteria set for this study were not equivalent. However, the authors were aware of this possibility and every effort was made to devise equivalent criteria for classification of auditory and visual deficits.

The notion that auditory process deficits, once identified, can be remediated cannot be confirmed or validated from the results of this study. The learning-disabled students in this study who had auditory process deficits did not improve in their auditory abilities over the 40 hours of auditory process training. Table 4, ANOVA of the post G-F-W subtests, and Table 6,

Duncan's Multiple Range Test, reveal no significant differences between treatments for any of the five auditory skills measured by the G-F-W. Subjects who had the benefit of 40 hours of auditory process training using commercially available materials (and teacher-made materials as necessary) failed to show improvement in their auditory skills when compared to subjects in a visual process training and reading treatment and a reading only treatment. Other studies have also demonstrated the lack of process skills improvement (Wilson, Harris and Harris, 1976; Hammill, 1972; Hammill and Larsen, 1974; Sowell, 1975). Process training remains essentially non-validated for increasing process skills.

Table 5 indicates that there were significant differences in achievement for the Word Knowledge and Reading variables of the MAT. Table 6, Duncan's Multiple Range Test, reveals that the Visual Process Training and Reading treatment was statistically superior to both the Auditory Training and Reading treatment and the Reading Only treatment for the MAT Word Knowledge variable. This would tend to indicate that the ability to recognize words and attach a meaning to them is related to the visual process and that it is possible to improve this skill in auditorally deficient youngsters by using visual process training.

It is necessary to further qualify this finding. Visual process training advocates have pointed out that this type of training is most effective at K-2nd grade levels (Frostig and Horne, 1964). Several subjects in the Visual Process Training and Reading treatment were well above the ages recommended for using Frostig, DLM and other visual training exercises. It was then necessary to use exercises recommended by Bush and Giles, the MWM kit, and branching activities developed by the Learning Lab staff. The nature of these visual activities often closely resembled the type of activities which

are very often found in reading programs and in the reading IEPs for all of the students. The staff often found it very difficult to derive strictly "visual process activities" which did not in essence become reading activities. One should be very cautious in advocating visual process training activities from these results.

In addition to the statistically significant finding for the Word Knowledge variable, statistically significant results were also found for the MAT Reading variable. The Duncan Multiple Range Test for this variable (Table 7) indicates that the Visual Training and Reading treatment was superior to the Auditory Training and Reading group. Visual Training and Reading was not superior to Reading Only treatment, nor was the Reading Only treatment superior to the Auditory Training and Reading treatment. Once again, the explanation for this finding is the same as was stated for the Word Knowledge finding; however, it should be noted that, at a level where comprehension of what is read is essential, the effects of visual training and reading are not superior to a treatment oriented only to reading.

At this point some discussion of the process training activities is appropriate. A great deal of time and energy was devoted to the review of various auditory and visual process training kits and to the development of additional activities. It should be noted here that over the entire year of the study no single auditory or visual skills training program was found to be usable by the teachers and students without considerable modification. These modifications included added branching and activities for practice at various skill levels and added levels of skill development for many of the skills taught by the programs. Often it was found necessary to add activities for practice or as extra steps in programs where steps from one level to another were felt to be too large. It was not possible, within the scope of the study,

to develop from the available materials a new, well-organized synthesis of process training activities. Activities were added and branching done as the need arose on an individual basis. A synthesis of auditory or visual process training activities would be a commendable project for those who advocate process training. At present, an LD teacher would be forced to spend a considerable amount of time in modification of programs in order use them effectively with students. Too, auditory process training has not yet been shown to be effective for increasing auditory skill abilities or for increasing reading achievement. While visual process training activities may be of benefit, the differences between visual training activities and reading activities become minimal as reading grade level increases. Still more importantly, even the definition of learning disabilities of the USOE places a good deal of emphasis on process deficits. However, there are no instructional programs upon which the teacher can rely to obtain significant improvement in either process skills or academic achievement. If this notion persists, LD teachers are doomed to failure.

Another point in favor of the Reading Only treatment is the fact that the two process groups in fact had more teacher attention in instruction. While the process groups were engaged in their training activities with teacher or student teacher direction, the Reading Only groups were engaged in non-reading-related activities. This group was provided with non-academic games, or enrichment activities, or was allowed to do work from their home schools. At the same time the process groups received more teacher attention during process activities, used audio-visual machines and played process training games.

There are, however, limitations to the study. The small sample size of the study limits the power of the ANOVA and the confidence which is placed

in the statistics. In addition, the study of process training activities for the visual skills deficit group was not possible. Replication of the study with a larger number of subjects would certainly lend more credibility to the results of such an undertaking. Also, it would be interesting to observe the incidence rate for visual and auditory skills deficits in a larger LD sample. The incidence rate of process skills deficits has yet to be determined, and this could provide useful information to professionals who construct tests or develop programs and to the consumers of such tests and programs.

The process tests did tap some variables peculiar to this sample of LD subjects, since 80% of the sample met a process deficit criterion. The usefulness of that information remains questionable. Training to remediate these skills or training to capitalize on strengths had little more effect on reading achievement than did teaching only the task of reading. Possibly the best use of process test information would be for the LD teacher to use it in constructing reading activities and manipulating the learning environment. The teacher may best use results indicating poor auditory selective attention by working with those youngsters on a one-to-one basis in a quiet area or by assigning independent activities on tape or record that can be listened to on headphones. Handwriting drills may be used to overcome poor visual-spatial relations or auditory memory may be attached to dictation while at the same time accomplishing the academic task of a spelling drill. At this time, the best recommendation for the use of process test information would be to integrate these results into academic teaching strategies and not to attempt remediation of skills separate from academic instruction.

References

Barr, A.J., Goodnight, J.H., Sall, J.P., and Helwig, J.T. A user's guide to SAS·76. Raleigh, N.C.: SAS Institute, Inc., 1976.

Berry, K.E., and Buktenica, N.A. Developmental Test of Visual-Motor Integration. Chicago: Follett Publishing Co., 1967.

Bush, W.J., and Giles, M.T. Aids to psycholinguistic teaching. Columbus, Ohio: Charles E. Merrill, 1969.

Colarusso, R.O., and Hammill, D.D. Motor-Free Visual Perception Test. San Rafael, Calif.: Academic Therapy Publications, 1972.

Cronbach, L.J. The two disciplines of scientific psychology. American Psychologist, 1957, 12, 671-684.

Dayton, C.M. The design of educational experiments. New York: McGraw-Hill, 1970.

Developmental Learning Materials: Auditory perceptual training. Niles, Ill., 1976.

Durost, W.N., Bixler, H.H., Wrightstone, J.W., Prescott, G.A., and Balow, I.H. Metropolitan Achievement Test. New York: Harcourt, Brace, Jovanovich, 1971.

Frostig, M. Developmental Test of Visual Perception. Palo Alto, Calif.: Consulting Psychologist Press, 1961.

Frostig, M. Education for children with learning disabilities. In H. Myklebust (Ed.), Progress in learning disabilities, Vol. I. New York: Grune & Stratton, 1968, pp. 234-266.

Frostig, M., and Horne, D. Frostig program for the development of visual perception. Chicago: Follett Publishing Co., 1964.

Goldman, R., Fristoe, M., and Woodcock, R.W. Goldman-Fristoe-Woodcock Auditory Skills Test Battery. Circle Pines, Minn.: American Guidance Service, 1975.

Hammill, D.D. Training visual perceptual processes. Journal of Learning Disabilities, 1972, 5, 39-46.

Hammill, D.D., and Larsen, S.C. Relationship of selected auditory perceptual skills and reading ability. Journal of Learning Disabilities, 1974, 7, 429-435.

Hammill, D.D., and Larsen, S.C. The effectiveness of psycholinguistic training: A reaffirmation of position. Exceptional Children, 1978, 44, 402-414.

Kirk, S.A., and Kirk, W. Psycholinguistic learning disabilities: Diagnosis and remediation. Urbana, Ill.: University of Illinois Press, 1971.

Kirk, S.A., McCarthy, J.J., and Kirk, W. Illinois Test of Psycholinguistic Abilities, Urbana, Ill.: University of Illinois Press, 1968.

Kramer, C.T. Extension of multiple range tests to group means with unequal numbers of replication. Biometrics, 1956, 12, 307-310.

Lund, K.A., Foster, G.E., and McCall-Perez, F.C. The effectiveness of psycholinguistic training: A re-evaluation. Exceptional Children, 1978, 44, 310-319.

Minskoff, E.H. Research on psycholinguistic training: Critique and guidelines. Exceptional Children, 1975, 42, 136-144.

Minskoff, E., Wiseman, D.E., and Minskoff, G. The MWM program for developing language abilities. Ridgefield, N.J.: Educational Performance Associates, 1972.

National Advisory Committee on Handicapped Children: First annual report, subcommittee on education of the Committee on Labor and Public Welfare, U.S. Senate. Washington, D.C.: U.S. Government Printing Office, 1968.

Prescott, G.A. Manual for interpreting the Metropolitan Achievement Test. New York: Harcourt, Brace, Jovanovich, Inc., 1973.

Resnick, L.B., Wang, M.C., and Kaplan, J. Task analysis in curriculum design: A hierarchically sequenced introductory mathematics curriculum. Journal of Applied Behavior Analysis, 1973, 6, 679-709.

Siegal, E. Task analysis and effective teaching. Journal of Learning Disabilities, 1972, 5, 61-78.

Sowell, V.M. The efficacy of psycholinguistic training through the MWM program. Unpublished doctoral dissertation, University of Texas at Austin, 1975.

Vellutino, F.R. Has the perceptual deficit hypothesis led us astray? Journal of Learning Disabilities, 1977, 10, 375-383.

Wiederholt, J.L. Predictive validity of Frostig's constructs as measured by the Developmental Test of Visual Perception. Dissertation Abstracts, 1971, 33, 1556-A.

Wilson, S.P., Harris, C.W., and Harris, M.T. Effects of an auditory perceptual remediation program on reading performances. Journal of Learning Disabilities, 1976, 9, 670-678.

Appendices

Table 1 ..... Subjects by Dysfunction Group and by Assignment to Treatment Group

Table 2 ..... Subjects' Characteristics in Final Statistical Analysis

Table 3 ..... Auditory Dysfunction Group: Means for G-F-W and MAT Pre and Post Treatment

Table 4 ..... Analysis of Variance of Five Subtests of the G-F-W

Table 5 ..... Analysis of Variance of Standard Scores for Three Subtests of the Metropolitan Achievement Test

Table 6 ..... Duncan's Multiple Range Test

Table 7 ..... Duncan's Multiple Range Test

	Auditory Training and Reading	Visual Training and Reading	Reading Only	N	% of Sample
Auditory Process Dysfunction	12	11	11	34	60
Visual Process Dysfunction	3	3	3	9	20
Undetermined Process Dysfunction	4	3	3	10	20

Table 1

Subjects by Dysfunction Group and by
Assignment to Treatment Group

Table 2

Subjects' Characteristics in Final Statistical Analysis

	Auditory Training and Reading	Visual Training and Reading	Reading Only
N	8	6	8
C.A.	9 yrs, 3 mos	9 yrs, 7 mos	8 yrs 11 mos
FSIQ	92.1	89.1	94.1

Table 3

Auditory Dysfunction Group

Means for G-F-W and MAT
Pre and Post Treatment

TEST	Auditory Training and Reading	Visual Treatment and Reading	Reading Only
G-F-W:			
Selective Attention			
pre	95.25	98.3	93.0
post	95.50	96.1	96.7
Discrimination			
pre	96.0	96.5	95.5
post	96.0	97.3	93.8
Recognition Memory			
pre	93.0	92.3	91.2
post	91.8	86.6	93.1
Memory for Content			
pre	16.5	16.0	15.4
post	21.1	20.6	18.5
Memory for Sequence			
pre	32.7	38.0	26.1
post	31.0	38.0	28.8
MAT:			
Word Recognition Standard Score			
pre	45.5	51.67	43.29
post	44.25	59.16	50.38
Reading Standard Score			
pre	41.13	49.0	44.86
post	40.87	53.0	47.38
Math Standard Score			
pre	49.14	46.17	49.75
post	56.12	48.60	49.75

Table 4

Analysis of Variance of Five Subtests of the GFW

Subtest	Source	DF	SS	MS	F	P>F
Auditory Selective Attention	MODEL	8	395.46	49.43	2.30	0.087
	ERROR	13	279.13	21.47		
	Corrected Total	21	674.59			
Auditory Discrimination	MODEL	8	165.98	20.74	0.76	0.6433
	ERROR	13	355.33	27.33		
	Corrected Total	21	521.31			
Recognition Memory	MODEL	8	1150.85	143.86	0.88	0.5550
	ERROR	13	2116.96	162.84		
	Corrected Total	21	3267.81			
Content Memory	MODEL	8	181.75	22.72	0.89	0.5530
	ERROR	13	333.20	25.63		
	Corrected Total	21	514.95			
Sequential Memory	MODEL	8	1587.35	198.42	2.17	0.1029
	ERROR	13	1187.24	91.32		
	Corrected Total	21	2774.59			

Table 5

Analysis of Variance of Standard Scores for
Three Subtests of the Metropolitan Achievement Test

Subtest	Source	DF	SS	MS	F	P>F
Word Knowledge	Treatment	2	778.86	389.43	8.51	0.005
	FSIQ	1	426.34	426.34	9.32	0.01
	WORDSA	1	1141.36	1141.36	24.94	0.0003
	READSA	1	208.97	208.97	4.57	0.05
	MATHSA	1	55.91	55.91	1.22	0.29
	ERROR	12	549.19	45.76		
	Corrected Total	18	3160.63			
Reading	Treatment	2	446.73	223.37	5.96	0.0160
	FSIQ	1	584.19	584.19	15.98	0.0019
	WORDSA	1	1051.15	1051.15	28.04	0.0002
	READSA	1	4.17	4.17	0.11	0.7444
	MATHSA	1	91.99	91.99	2.45	0.1432
	ERROR	12	449.86	37.49		
	Corrected Total	18	2628.09			
Arithmetic	Treatment	2	225.82	112.91	1.39	0.2855
	FSIQ	1	1429.53	1429.53	17.65	0.0017
	WORDSA	1	465.63	465.63	5.75	0.0333
	READSA	1	10.29	10.29	0.13	0.7277
	MATHSA	1	1657.44	1657.44	20.46	0.0007
	ERROR	12	972.02	81.00		
	Corrected Total	18	4760.73			

Table 6

Duncan's Multiple Range Test

Variable	DF	MS	**Grouping	Alpha Level	N	*Treatment	Mean
Auditory Selective Attention	13	21.47	A A A A A	.05	8 6 8	3 2 1	96.750 96.167 95.500
Discrimination	13	27.33	A A A A A	.05	6 8 8	2 1 3	97.333 96.000 93.875
Recognition Memory	13	162.84	A A A A A	.05	8 8 6	3 1 2	93.125 91.875 86.667
Memory for Content	13	25.63	A A A A A	.05	8 6 8	1 2 3	21.125 20.667 18.500
Memory for Sequence	13	91.32	A A A A A	.05	6 8 8	2 1 3	38.000 31.000 28.875

*Treatments:
1 Auditory Training and Reading
2 Visual Training and Reading
3 Reading Only

** Means with the same letter are not significantly different.

Table 7

Duncan's Multiple Range Test

Variable	DF	MS	** Grouping	Alpha Level	N	* Treatment	Mean
Word Knowledge	12	45.76	A B B B	.05	6 8 8	2 3 1	59.167 50.375 44.250
Reading	12	37.49	A A A B B B	.05	6 8 8	2 3 1	53.000 47.375 40.875
Arithmetic	12	81	A A A A A	.05	8 8 5	1 3 2	56.125 49.750 48.600

*Treatments:
1 Auditory Training and Reading
2 Visual Training and Reading
3 Reading Only

** Means with the same letter are not significantly different.